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CASE REPORTS

Carpometacarpal joint dislocations of the index to small finger: Three cases and a review of the literature

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Introduction

Dislocations of the carpometacarpal (CMC) joints are uncommon injuries. They represent less than 1% of all injuries to the hand and wrist regions.[5] Up to 70% of carpometacarpal dislocations are missed or misdiagnosed.[7] In addition, in patients with multitrauma, treating physicians may be overwhelmed by other injuries that require more urgent attention.

Carpometacarpal dislocations will cause disruption of both the longitudinal and transverse arches of the hand, and loss of the normal axial length of the involved digit. In addition, dorsal subluxation of the proximal phalanx on the metacarpal head can occur, leading to flexion contracture of the proximal interphalangeal joint. Delayed diagnosis and treatment will usually result in undesirable outcome of pain, reduced grip strength, and degenerative arthritis.[9] Up to 43% of patients with neglected single CMC joint injuries will experience residual pain and impaired function. However with appropriate management, up to 87% of patients with CMC joint injuries will return to full work and sporting activities with negligible pain.[13] As such, every attempt should be made to diagnose carpometacarpal dislocations early, and initiate appropriate treatment to improve functional outcome of the injured hand.

We highlight three cases of carpometacarpal dislocations with differing mechanisms of injury and varied presentation and discuss the successful treatment of each case.

Case 1

A 34-year old male was kicked in his dominant right hand in a soccer game. He complained of immediate pain over the dorsum of the hand and painful active movement of the index to small fingers. On examination, there was marked swelling over the dorsum of the right hand. There was minimal movement of the fingers due to pain.

Radiographs revealed fracture of the base of the second metacarpal with dorsal dislocation of the third CMC joint and an avulsion fracture of the base of the fifth metacarpal (Fig. 1a and b). He underwent surgery on the same day. Intra-operatively, a comminuted fracture of the second metacarpal base was noted. The second carpometacarpal joint was stable. The third carpometacarpal joint was dislocated dorsally, with disruption of the dorsal ligamentous and

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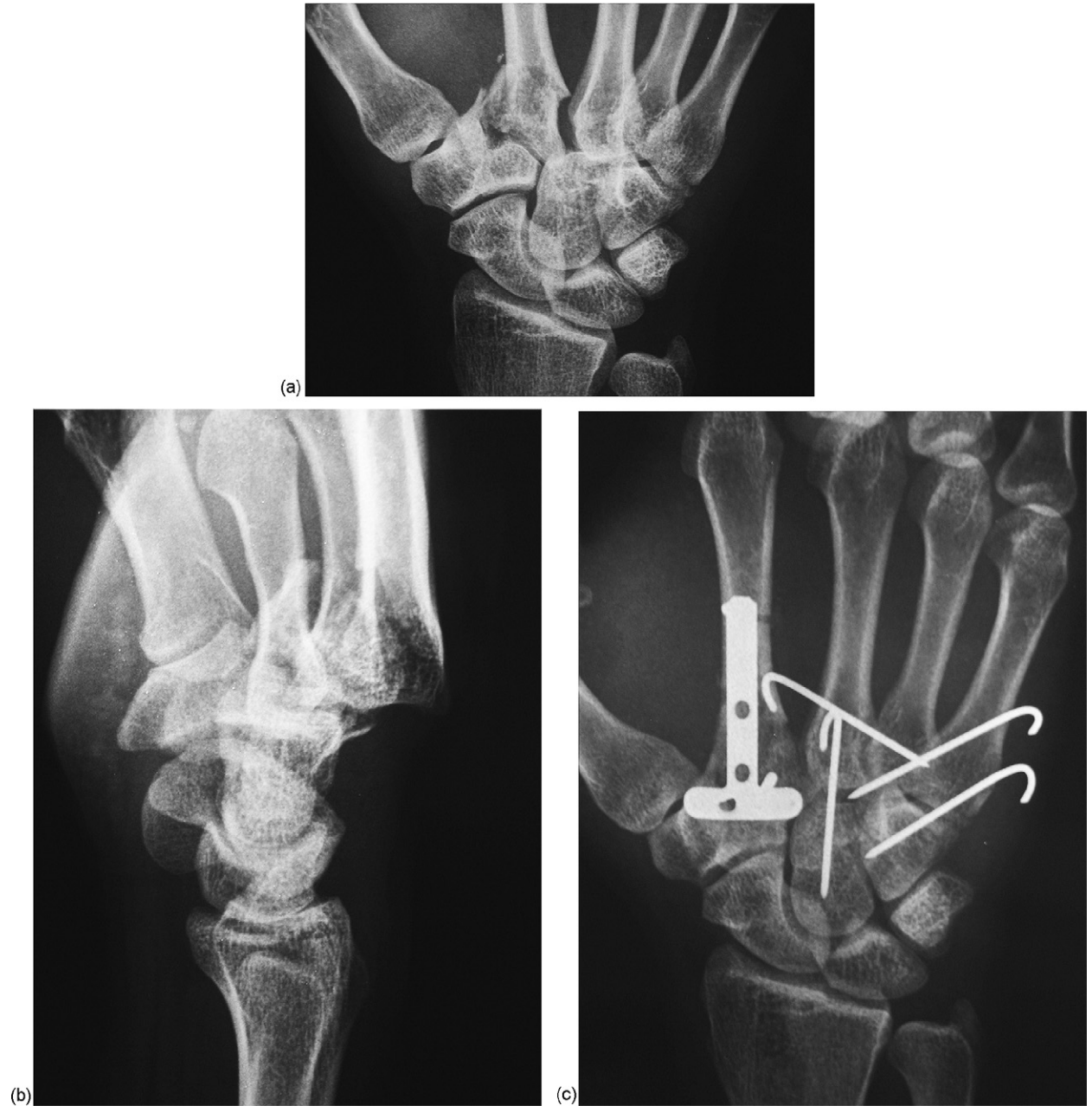

Figure 1 (a) PA radiograph showing fracture of the second metacarpal base and dorsal dislocation of the third CMC joint. Minimally displaced avulsion fracture of the base of the fifth metacarpal is noted. Despite maintenance of parallelism at the fourth and fifth CMC joints, these joints were unstable to longitudinal traction under fluoroscopic examination. (b) True lateral radiograph showing dorsal displacement of second and third metacarpals. (c) Post-operative PA radiograph showing fracture of the second metacarpal base fixed with plate and screws, and ulnar three CMC joints pinned with K-wires.

capsular structures. Dynamic stress fluoroscopic evaluation revealed that both the fourth and fifth carpometacarpal joints were unstable dorsally.

The fracture of the second metacarpal was reduced and stabilized with an AO 2.0 mm T-plate. Trephined bone graft was harvested from the dorsal aspect of the ipsilateral distal radius, and impacted into the comminuted fracture site. The second CMC joint was stable and not subluxated. The dislocations of the third, fourth and fifth carpometacarpal joints were reduced and stabilized with K-wires.

Case 2

A 25-year old male sustained injury to his dominant right hand when he punched the wall with a

clenched fist. He complained of pain and swelling over the ulnar-dorsal aspect of his right hand.

Examination revealed ulnar deviation of the small finger and bony swelling over the dorsum at the base of the fifth metacarpal. Grip strength and active range of motion at the finger joints were reduced. There was no small finger paresthesia.

Radiographs revealed isolated dorsal dislocation of the fifth carpometacarpal joint. There were no associated fractures.

Manipulation and reduction was performed under fluoroscopic guidance on the day of injury. The fifth carpometacarpal joint was easily reduced and found to be stable post-reduction. He was placed in a dorsal below elbow plaster and mobilized after 1 month. At follow-up after 3 months, the fifth carpometacarpal joint remained reduced and he grip strength was comparable to his non-dominant hand.

Case 3

A 23-year old right hand dominant male presented 1 week after falling and landing on the knuckles of his clenched right fist. He developed pain and swelling over the ulno-dorsal aspect of his right hand. He also had a history of falling on his outstretched right hand during a soccer game 1 year ago, with intermittent wrist pain since then.

Examination revealed a dorsal prominence over the base of the fourth metacarpal accompanied by swelling. There was no ulnar deviation of the small finger. Active range of motion of the right ring and small fingers was inhibited by pain.

Radiographs revealed fracture-dislocation of the base of the fourth metacarpal and dislocation of the fifth CMC joint. An old fracture of the proximal pole of the scaphoid with cystic changes was also noted.

Under anesthesia, ballottement of the fourth and fifth CMC joints revealed dorsal instability. The joints could easily be dislocated and reduced. Open reduction and K-wiring of the fourth and fifth CMC joints was performed through a dorsal incision. At the same time, screw fixation and bone grafting of the scaphoid was performed through a dorsal approach.

Discussion

The carpometacarpal joints are anatomically stable joints. Stability arises as a result of (1) interlocking saddle joints, (2) volar and dorsal ligaments, and intermetacarpal ligaments, and (3) protection by the long flexor and extensor tendons and intrinsic muscles.[5,11] However, the ulnar-side CMC joints are less stable due to the shallower, more mobile saddle joint configurations, and looser ligamentous attachments of the ulnar two CMC joints. The third CMC joint is also more proximally located, producing the keystone phenomenon with the other CMC joint.[4] The fifth CMC joint is the least stable and most commonly dislocated, a finding notable in all three cases described.

These injuries are often associated with concomitant carpal fractures or metacarpal base avulsion fractures due to the strong attachments of the carpometacarpal ligaments.[3,5,7,13] When these ligaments remain intact, the resultant forces produce avulsion fractures instead of dislocations. Otherwise, isolated dislocation of the carpometacarpal joint will occur. This is illustrated in case 1, where the second metacarpal fractured at the base but the index CMC joint was not dislocated. In case 3, the fourth CMC joint fracture-dislocation was a result of the intact ligaments holding on to a large fragment of metacarpal base.

CMC joint dislocations can be a product of high-energy trauma, such as motor-vehicle accidents or falls from height, or low-energy trauma, such as fist fights, or a fall on the hand.[3,5,7,13,16] Dislocations frequently occur due to a direct force centred at the metacarpal base, as seen in case 1,[14] although indirect force transmitted down the metacarpal shafts, as seen in cases 2 and 3, can produce similar dislocations.

Dorsal dislocations are commonest.[3,6–8] In case 1, the kick was delivered to the palmar surface, producing a dorsally directed force. In cases 2 and 3, indirect trauma to the metacarpal heads resulted in a turning moment, levering the metacarpal base dorsally. The gentle volar angulation of the metacarpal shaft also favours dislocations in the dorsal direction. Less common volar and divergent dislocation patterns have been described.[4,12]

Early diagnosis of CMC joint dislocation requires a high index of suspicion based on the mechanism of injury, and detailed clinical examination to identify deformities and neurological deficits that typify such injuries.

Dorsal dislocations produce a prominent deformity on the dorsal aspect of the hand.[5] With the extent of injury in case 1, generalised swelling over the entire dorsum of the hand was present, masking the characteristic ''lump''. In cases 2 and 3, the bony lump over the dorsum was easily identified. Ulnar deviation of the small finger is characteristic of fifth CMC joint dislocation.[7] This finding was notable in case 2. The deep branch of the ulnar nerve may be compressed between the fourth metacarpal base and origins of the flexor digiti quinti brevis and opponens digiti quinti in volar dislocation of the fourth CMC joint. This leads to weakness of

Figure 2 (a) PA radiograph showing displacement of the fifth metacarpal head below Chmell's oblique metacarpal line. Loss of parallelism is not apparent. (b) Oblique radiograph showing isolated dislocation of the fifth CMC joint. (c) True lateral radiograph of isolated fifth CMC joint dislocation. The angle subtended between long axes of second and fifth metacarpals measures 39°. This is consistent with fifth CMC joint dislocation.

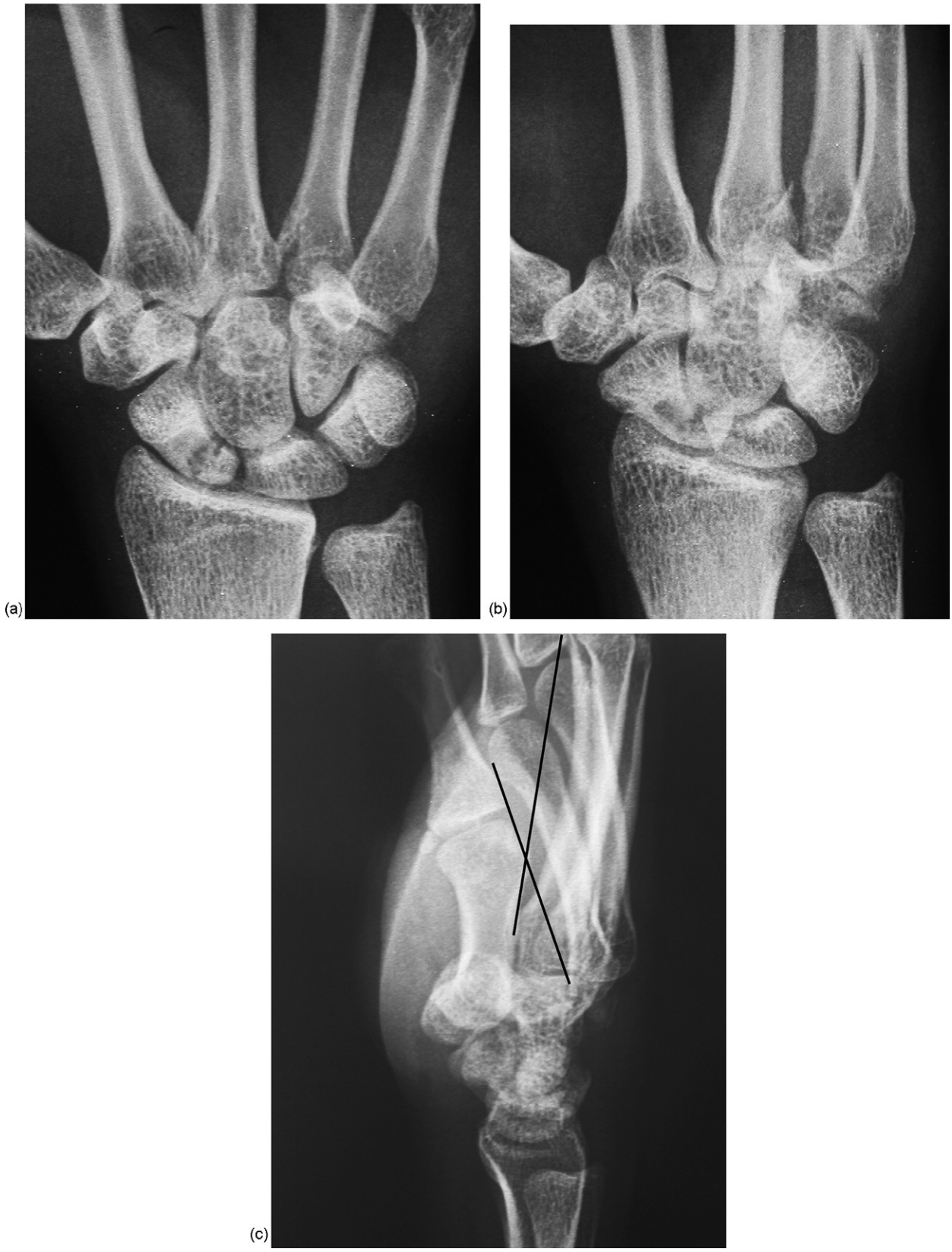

Figure 3 (a) PA radiograph showing fracture-dislocation of the fourth CMC joint and dislocation of the fifth CMC joint. There is loss of parallelism at both joints. (b) Oblique radiograph revealing the fracture-dislocation of fourth CMC and dislocation of fifth CMC joints clearly. (c) True lateral radiograph showing dorsal displacement of fourth and fifth metacarpal heads. The angle between long axis of second and fifth metacarpals measures 30°.

the interrossei and adductor pollicis, which manifests clinically as separation of the long and ring fingers on making a fist.[2] Metacarpophalangeal joint dislocation or thumb CMC joint dislocation are other associated findings.[5]

Radiographs should include the postero-anterior (PA), oblique, and true lateral views of the hand. On a PA view, the undisplaced CMC joint is bounded by parallel articular surfaces of 1.0—2.0 mm,[5] forming a broad letter ''M'' bounded proximally by the distal articular surfaces of trapezoid, capitate and hamate, and distally by the bases of second through fifth metacarpals. In CMC dislocation, this parallelism is replaced by overlap of joint surfaces with a possible offset at the base of the fifth metacarpal.[1] Fractures of the metacarpal bases or of the hamate, shortening of the metacarpals with reference taken from the oblique metacarpal line, or avulsion fractures of the involved metacarpal are other ominous signs of CMC joint dislocation.[7,13] In case 1, the PA radiograph revealed loss of parallelism at the third carpometacarpal joint and joint surface overlap. In case 2, the PA radiograph revealed displacement of the fifth metacarpal head below the oblique metacarpal line (Fig.2a). The dislocation is better seen on the oblique projection (Fig.2b).

The true lateral radiograph of the hand is invaluable in demonstrating dorsal or volar displacement of the metacarpal base.[6,7,15] This is clearly visible for cases 1 and 3. On this projection, the angle subtended between the long axes of the second and fifth metacarpal bones can be measured. Parkinson found that the angle is greater in cases of fifth CMC joint dislocation (mean angle, 38.5°) than in controls with undisplaced CMC joints (mean angle, 9.8°).[15] In cases 2 and 3 (Figs. 2c and 3c), the angles measured 39° and 30° respectively, suggestive of fifth CMC dislocation.

Other useful radiographic views include pronation views which help visualize the CMC joint of the index finger, and supination views, which illustrate the CMC joints of the ring and small finger.[5,10] Interpretation of these views may be challenging, and computed tomography (CT) may be preferred to help delineate the relationship between CMC joint surfaces with clarity. CT is especially useful in arriving at an accurate diagnosis where other complex carpal injuries are present.[11]

Management options include closed reduction and splintage immobilization, closed reduction and K-wire fixation, or open reduction and internal fixation. The choice of treatment depends on the severity and stability of the CMC joints, and the expertise of the attending physician.

Isolated fifth CMC joint dislocation may be reduced closed and splinted if it is stable post-reduction, such as in case 2. However, maintaining the reduction against the pull of the extensor carpi ulnaris and flexor carpi ulnaris may be difficult. Close follow-up physical examinations and radiographs are necessary to confirm that reduction is maintained.

Similarly, closed reduction alone is easily achieved for dislocations at the other CMC joints by longitudinal traction and direct pressure over the metacarpal bases. However, Kirschner wire fixation is commonly employed to maintain the reduction. This method is usually successful for dislocations less than 10 days old, before the onset of massive edema.[7,8] The disadvantages of this approach include non-anatomic reduction, difficulty in pinning small bone fragments, and risk of tendon transfixion. The optimum duration that the wires are left in place remains debatable. Most authors recommend keeping the wires in place for between 6 weeks to 3 months.[1,4,5] However, earlier removal will avoid complications of skin pressure necrosis and impairment of tendon gliding.[3] The duration of fixation, however, has not been shown to affect outcome, grip strength, or range of wrist motion.[13]

Open reduction is indicated in cases with overlapping metacarpal bases, massive edema, or where interposed ligaments avulsed bone fragments prevent closed reduction, where closed manipulation has failed, or in chronic dislocations more than 3 weeks old.[1,3,6,7,10] The dorsal approach is usually chosen for unobstructed access to the carpometacarpal complex.[12] In cases of multiple dislocations, it is critical to first stabilize the base of the third metacarpal.[12] Compared with closed reduction and K-wire fixation, open reduction provides the advantage of a more anatomical joint restoration, and avoids the risk of tendon transfixion.

Summary

Carpometacarpal joint dislocations of the index to small finger are uncommon injuries of the hand. The attending physician needs to have a high index of suspicion and be aware of this injury pattern in order for early accurate diagnosis. There are various clinical signs and radiographic features that are useful to aid diagnosis. Initiating appropriate treatment early will help improve the functional outcome of the injured hand.

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